Teton River Subbasin Assessment And Total Maximum Daily Load

Photo courtesy of Timothy Randle, Bureau of Reclamation

Department of Environmental Quality

January 10, 2003

Horseshoe Creek

Horseshoe Creek is impaired due to flow alteration. However, the EPA does not believe that flow (or lack of flow) is a pollutant as defined by section 502(6) of the CWA. DEQ is not required to establish TMDLs for waterbodies impaired by pollution but not pollutants, so it is the policy of the state of Idaho to not develop TMDLs for flow alteration. Horseshoe Creek is not impaired by any other pollutants, so no TMDLs will be established for this creek.

Moody Creek

Moody Creek originates on the northeastern slope of the Big Hole Mountains and is the only major tributary of the South Fork Teton River. From the confluence of North Moody Creek and South Moody Creek on the Caribou-Targhee National Forest, the mainstem flows north and west 16 miles through a basalt canyon that reaches depths of 400 feet. After exiting the canyon, Moody Creek's natural channel is replaced by almost 2 miles of ditches and canals that direct its flow into irrigation canals or the South Fork Teton River.

The Moody Creek drainage has been divided into two watersheds: Moody Creek and Parkinson (Figure 6). Together, these watersheds drain an area of 172 square miles or 110,549 acres. Approximately 11% of this area is managed by the Caribou-Targhee National Forest, 8% is managed by the Idaho Department of Lands, and the remainder is privately owned. Public lands are used for grazing, timber production, recreation, motorized travel, and elk and deer winter range (USDA 1997a); private lands are used primarily as irrigated and nonirrigated cropland.

North Moody Creek, South Moody Creek, and the mainstem of Moody Creek on the Caribou-Targhee National Forest are located within ecological units 2606, 2609, and 1224 (Bowerman *et al.* 1999). Unit 2606 is a moist floodplain characterized by a flat bottom, moderate gradient, and frequent flooding. Seasonal variation in streamflow is dominated by snowmelt. Unit 2609 is characterized by low to high gradient (2-8 percent) floodplains in U-shaped mountain valleys. The soils have a very slow infiltration rate when thoroughly wet due to a high shrink-swell potential and/or permanent high water table, and therefore have a high runoff potential. Flooding is frequent and lasts from April through July due to snowmelt. Susceptibility to water erosion is relatively low, as indicated by a K_w of 0.15. Unit 1224 is characterized by summits with rolling to hilly slopes and incised drainageways. Soils are very deep, slowly permeable, and susceptibility to water erosion is relatively high, as indicated by a K_w of 0.43.

On privately owned land, soils on either side of Moody Creek Canyon are deep, well-drained silt loams on level, gently sloping, strongly rolling, or hilly topography (USDA 1981).

Flow The USGS maintained staff and crest-stage gages on Moody Creek from 1979 through 1986 at a location approximately 8.5 miles downstream of the forest boundary and 8.5 miles upstream of the South Fork Teton River. Peak discharges occurred between late April and early June and ranged from 145 cfs to 528 cfs (Figure 37). Discharges less than 10 cfs generally occurred from July or August through February. According to the *U.S. Geological Survey Water-Data Report ID-81-1*, almost all of the flow in Moody Creek was sometimes diverted for irrigation upstream of the gage, so the discharge data were not necessarily representative of the natural flow regime of Moody Creek.

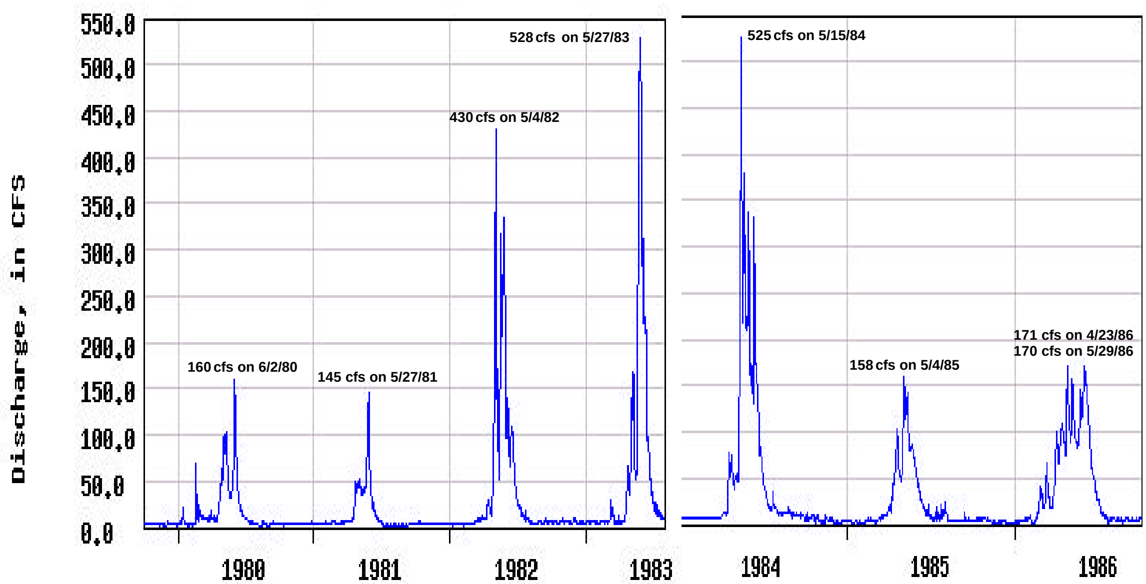

Figure 37. Daily mean discharges recorded from 10/1/79 to 7/31/83 and 1/1/83 to 9/30/86 at U.S. Geological Survey gage station 13055319, *Moody Creek near Rexburg Id.* Graphs were downloaded from the Idaho NWIS-W Data Retrieval page at http://waterdata.usgs.gov/nwis-w/id.

Flow in lower Moody Creek is highly modified by irrigation withdrawals and returns. According to Cleve Bagley of the NRCS field office in Rexburg, flow from Moody Creek reaches the South Fork Teton River during spring runoff and possibly in winter when discharge is sufficient. From April 1 to November 1 flow may be diverted at three locations, though all water rights are reduced by one-half after June 20. The first major diversion is located at T5N R41E S21, upstream of the USGS gage location and Woods Crossing. This diversion was responsible for the flow alteration described in the *U.S. Geological Survey Water-Data Report ID-81-1*. The second diversion is located almost 9 miles downstream from the first and has a diversion rate of 6.4 cfs. The third diversion is the Woodmansee Johnson Canal, which intersects with the channelized portion of Moody Creek approximately one mile east of the South Fork Teton River. All of the flow remaining in the channel may be diverted into the canal at this point.

A four-mile segment of lower Moody Creek upstream of the third diversion is usually dewatered after July (Huskinson personal communication). Water is present in the lower half of this segment because of irrigation return flows from the Enterprise Canal, East Teton Canal, and Teton Canal.

§303(d)-Listed Segment The segment of Moody Creek shown on the 1998 §303(d) list extends from the forest boundary to the Teton River. As explained above, Moody Creek discharges to the South Fork Teton River, not the mainstem Teton River, so the lower boundary was incorrectly identified. Because flow from Moody Creek discharges to the South Fork via a canal instead of a natural stream channel, it is not consistent with Idaho's water quality standards to identify the South Fork Teton River as the lower boundary for the purpose of assessing the support status of aquatic life beneficial uses. Furthermore, because a segment of lower Moody Creek is dewatered by legal appropriations of streamflow, the lower boundary should be located at a point upstream from this segment. Additional monitoring of Moody Creek will be required to determine the correct boundary location. The pollutant of concern shown on the 1998 § 303(d) list for Moody Creek was nutrients.

Three locations on Moody Creek were selected for BURP sampling in 1995 based on a review of USGS 7.5-minute topographic maps. The lower site was not sampled because it did not contain riffles. It was later determined that this site was inappropriate anyway because it was located on the Woodmansee Johnson Canal, not Moody Creek. The upper site, which was located on North Moody Creek, was not sampled because it was in a beaver complex. The middle site, located near Woods Crossing (Figure 38), produced an MBI score (3.07) within the "needs verification" range and a HI score (83) less than the value considered to support cold water aquatic life in the Snake River Plain ecoregion (89). It was subsequently determined that this site was approximately 2 miles downstream from the first major diversion on Moody Creek. Discharge at the time the site was sampled on August 21, 1995, was 3.8 cfs, and it is not known whether water was being diverted upstream.

In 1997, BURP sampling was conducted on three additional sites, all of which were upstream of the forest boundary and the confluence of North Moody and South Moody Creeks. The site on North Moody Creek (97-L015) produced one of the highest MBI scores in the Teton Subbasin (5.45), but the HI score was low (80). On South Moody Creek, the site furthest upstream (97-L014) produced high MBI (4.55) and HI (102) scores despite its location immediately downstream from its headwaters at a series of springs. The downstream site (97-M016) produced slightly lower MBI (3.92) and HI (91) scores. The beneficial use support status of these sites have not yet been assessed, but if they had been according to guidelines used to develop the 1998 §303(d)-list (DEQ 1998b), they would have been assessed as fully supporting cold water aquatic life.

Scores for substrate embeddedness and percentage of substrate fine sediment did not indicate that sediment was a greater problem downstream than upstream. Substrate embeddedness was rated optimal at the site on North Moody Creek and at the upstream site on South Moody Creek, and sub-optimal at the downstream site on South Moody Creek and at the site on Moody Creek near Woods Crossing. But the percentage of substrate fine sediment less than 1 mm in size was only 20% at the site on Moody Creek near Woods Crossing compared to 38% at the site on North Moody Creek, 72% at the upstream site on South Moody Creek, and 28% at the downstream site on South Moody Creek. The percentage of stable banks was less than the target of 80% at the site on North Moody Creek (71% stability on the left bank) and at the downstream site on South Moody Creek (56% stability on the left bank; 67% stability on the right bank).

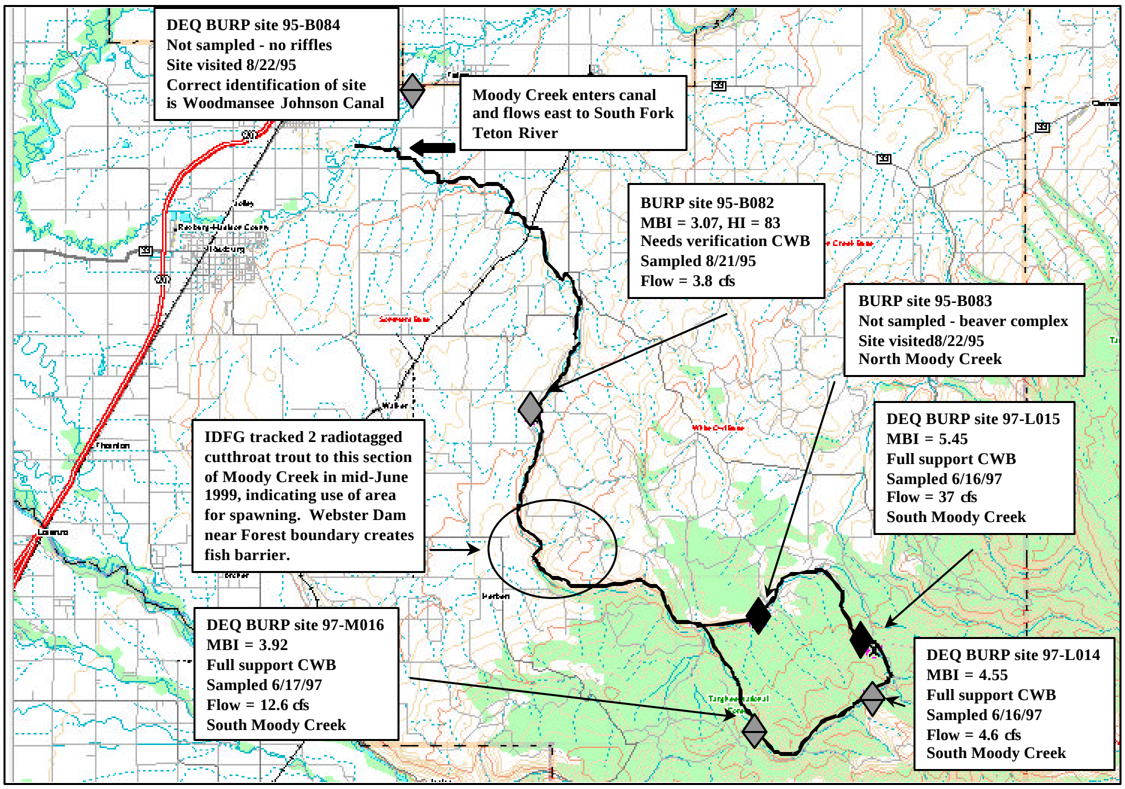

Figure 38. Data collection sites on Moody Creek and North and South Moody Creeks.

Resource Problems Moody Creek was originally placed on Idaho's §303(d) list because it was listed as an impaired stream segment in *The 1992 Idaho Water Quality Status Report* (DEQ 1992). Pastureland treatment and animal holding/management areas were identified by DEQ as sources of nitrate, the pollutant responsible for impairment. These land uses are essentially limited to the grazing lands located on the Caribou-Targhee National Forest and state endowment lands. Private lands are used for irrigated and nonirrigated crop production, and 17% of private farmland, particularly in the upper watershed, is currently enrolled in the Conservation Reserve Program (Figure 39). The segment of Moody Creek identified as impaired was below the forest boundary, implicating state endowment lands and private lands as the sources of nutrients.

Most of the endowment lands adjacent to the forest have been leased long-term by the Lyman Creek Grazing Association though income is also received from logging. In 1999, an assessment of the 6,125-acre allotment was conducted as part of the 10-year lease-renewal process (Hancock 2000). Proper functioning condition estimates were made for Moody Creek, State Creek, and an unnamed tributary of State Creek, and all were found to be in proper functioning condition. The high quality of the riparian areas appears to be due to two factors. First, most of Moody Creek is located in a canyon that is generally inaccessible to cattle, and second, an off-stream stock watering system was implemented in the early 1990s. Working with the NRCS field office in Rexburg, the Lyman Creek Grazing Association installed a water storage tank, pumphouse, and nine watering troughs to encourage cattle to remain away from streams and springs. Resource concerns identified in the assessment included 1) grazing use following timber harvest, 2) damage to riparian areas caused by off-road recreational vehicles, and 3) spotted knapweed in Moody Creek Canyon. The Idaho Department of Lands has addressed the problem of off-road vehicle damage by prosecuting offenders and building fences around susceptible areas.

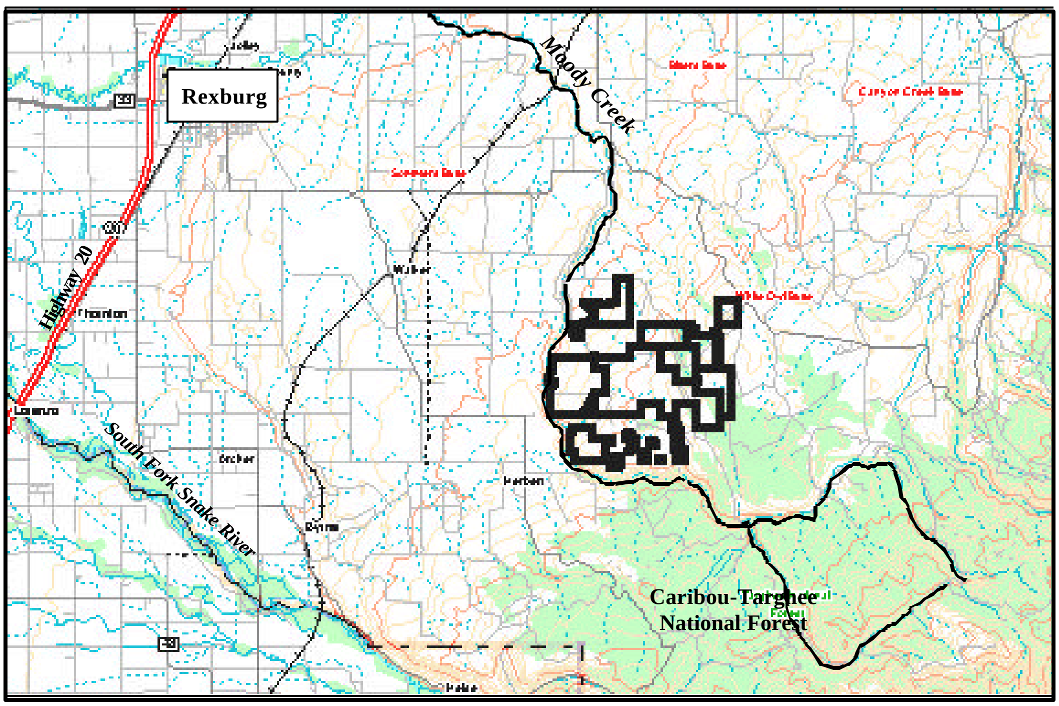

Figure 39. Cultivated lands in the middle Moody Creek watershed that are currently enrolled in the U.S. Department of Agriculture Conservation Reserve Program (CRP).

Turbidity measurements made at three locations on lower Moody Creek on June 10, 1999, were the highest recorded in the Teton Subbasin. At the elbow of Moody Creek, turbidity was 57 NTU, downstream of the Enterprise Canal turbidity was 204 NTU, and at the intersection with the Woodmansee Johnson Canal, turbidity was 70 NTU. These results indicated that sediment was being transported from some point upstream of the Elbow of Moody Creek and that additional sediment was being introduced to Moody Creek downstream of the Elbow, probably via the Enterprise Canal. Subsequent driving tours of North Moody and South Moody Creeks indicated that sediment was originating on the forest. Extensive streambank erosion was observed on North Moody Creek downstream of the confluence of Sheep Creek. Staff from

DEQ and the Caribou-Targhee National Forest toured the South Moody Creek, Fish Creek, and Hinckley Creek areas on August 3, 1999. Several sources of sediment and pathways for sediment delivery to streams were identified. These included, but were not limited to, road gullies caused by plugged or undersized culverts, severe downcutting in Fish Creek due to a hanging culvert, and gullies in temporary roads in clearcut areas east of Hinckley Creek.

Water Quality Data Nitrate concentrations did not exceed the target concentration of 0.3 mg/L in any of the Moody Creek water samples collected by DEQ in 2000. Samples were collected at five locations (Figure 40): North Moody Creek on the National Forest (site 21), approximately 2 miles below the first major diversion at Woods Crossing (site 22), approximately 4 miles upstream of the Enterprise Canal at the Elbow of Moody Creek (site 23), approximately 500 m below the Enterprise Canal (site 24), and approximately 0.5 miles below the Teton Canal (site 25). The lowest concentrations of nitrate were measured in North Moody Creek and ranged from less than detection level to 0.04 mg/L. Concentrations remained low at the two downstream sites, ranging from less than detection level to 0.13 mg/L at Woods Crossing and the Elbow of Moody Creek. The highest concentration of nitrate (0.29 mg/L) was measured downstream of the Enterprise Canal in August when flow in Moody Creek at this location was probably derived entirely from the canal's discharge. Concentrations of nitrate at the lowest site were the highest measured in June, and exceeded the concentrations measured at the closest upstream site by 0.11 to 0.19 mg/L. These results indicated that nitrate was introduced either from the East Teton and Teton Canals or from land use in the final 2 miles of Moody Creek.

The highest concentration of TSS measured in the Teton Subbasin in 2000 was measured in a sample collected from Moody Creek at Woods Crossing on August 24. However, this concentration (26.7 mg/L) was well below the designated target of 80 mg/L, and all other concentrations ranged from less than detection level to 16.4 mg/L. Concentrations of suspended solids increased from approximately 5 mg/L at the upstream sites on Moody Creek to 15 and 16 mg/L at the downstream sites on June 15, but a similar pattern of increasing concentration downstream was not observed on any other sampling date. The high turbidity values measured in 1999 were not measured in 2000, and maximum turbidity (7.8 NTU) was far below the criterion specified in Idaho's water quality standards (i.e., not greater than 50 NTU above background).

Water temperatures measured in 2000 exceeded the instantaneous criterion of 22 ^{o}C for cold water aquatic life on two occasions: on July 27 at the Elbow of Moody Creek (23.5 ^{o}C) and on August 24 below the Enterprise Canal (22.2 ^{o}C). At the most upstream site on North Moody Creek, two instantaneous temperature measurements exceeded 19 ^{o}C, the maximum daily average criterion for cold water aquatic life. These data indicate that long-term temperature monitoring is warranted in both the upper and lower reaches of the Moody Creek subwatershed.

Fisheries Brook trout and Yellowstone cutthroat trout occur throughout Moody Creek and in North and South Moody Creeks. Webster Dam, located approximately 1.5 miles downstream of the forest boundary and immediately upstream of the state endowment lands boundary, is considered a barrier to upstream fish migration (Schrader 2000a). This dam was built at the turn of the century to create a reservoir on Moody Creek, but an adjudication claim on the water rights issued in 1903 have not been filed (Olenichak 2000). According to Schrader (2000a) and Hancock (2000), the reservoir has filled with sediment and resembles a wet meadow.

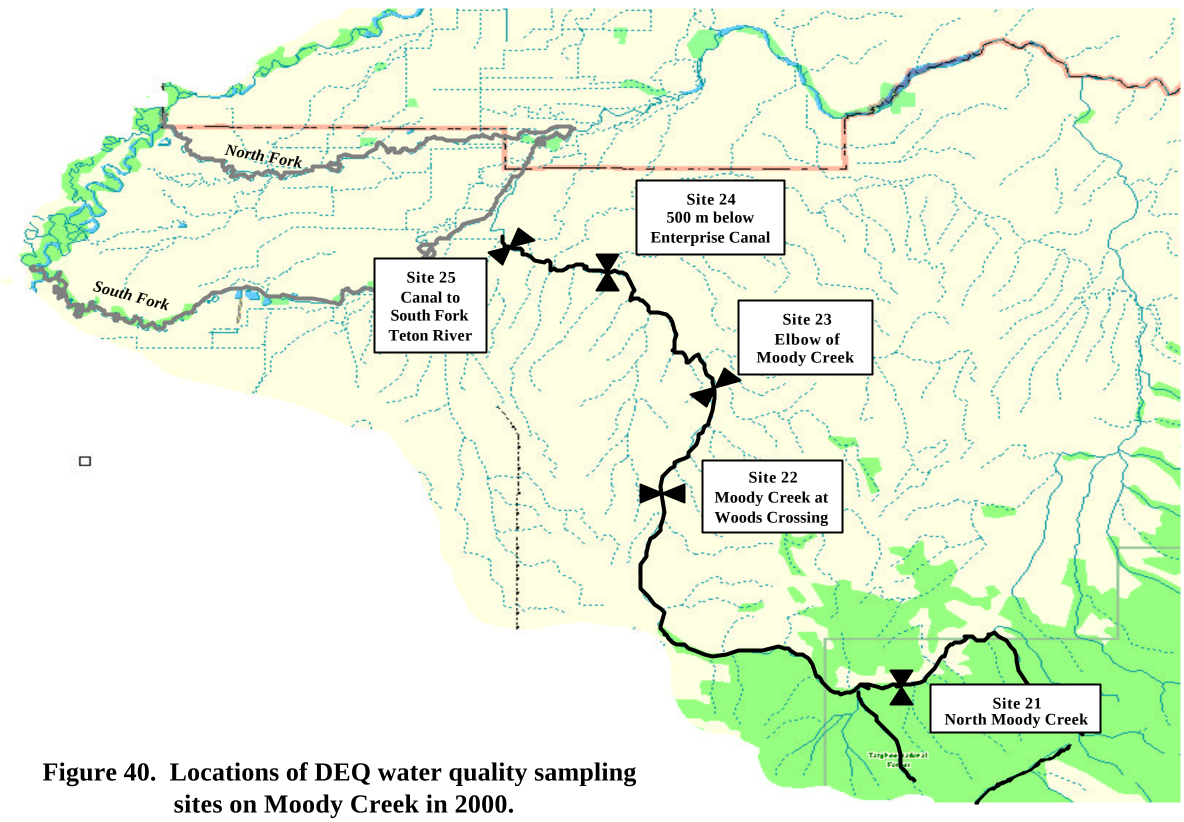

Figure 40. Locations of DEQ water quality sampling sites on Moody Creek in 2000.

Four locations in the Moody Creek watershed were recently electrofished by DEQ. Three year classes of brook trout, including juveniles, were collected on North Moody Creek at BURP site 97-L015 in September 1997. On the same day, two year classes of both brook trout and cutthroat trout were collected on South Moody Creek at BURP site 97-L014. South Moody Creek at BURP site 97-M016 was electrofished in July 1999, but no fish were collected. Moody Creek upstream of Woods Crossing was electrofished in September 1996 and one brook trout, 3 cutthroat trout, 76 sculpin, 71 speckled dace, 19 longnose dace, and 94 redshine shiners were collected. The length of the brook trout was between 170 and 179 mm; the lengths of the cutthroat trout were less than 100 mm and between 230 and 309 mm. According to the assessment process used to develop the 1998 §303(d) list (DEQ 1998b), these data support an assessment of full support for the beneficial use of salmonid spawning in North Moody Creek but not in South Moody Creek or the mainstem of Moody Creek.

During the study of the Teton Canyon fishery conducted by IDFG, two radiotagged cutthroat trout were observed to swim upstream from the South Fork Teton River into Moody Creek. These fish were located above Woods Crossing near the lower boundary of the state endowment lands during the week of June 17, 1999, where they are believed to have spawned (Schrader 2000a). Additional fish population and habitat survey data were collected by IDFG in the early 1990s and are currently being compiled (Schrader 2000a).

Data Collected Following Public Review of the Draft *Teton Subbasin Assessment and Total Maximum Daily Load (TMDL)* Since the draft version of this document was submitted for public comment in March 2001, a substantial amount of water quality and stream channel data have been collected and submitted to DEQ for use in the TMDL development process. At the request of the Madison Soil and Water Conservation District, the Idaho Association of Soil Conservation Districts has conducted bimonthly water quality sampling at three locations on lower Moody Creek since April 2001. During the summer of 2001, staff from the Caribou-Targhee National Forest surveyed the headwaters of Moody Creek as part of the forest's Yellowstone cutthroat trout management program.

The sampling locations and parameters measured by DEQ in 2000 and by Idaho Association of Soil Conservation Districts in 2001 were similar (Figures 40 and 40a), but the frequency of sampling and the analysis of phosphorus in 2001 provide a more representative data set than that obtained in 2000.

The results of water quality sampling for the period from April 18, 2001 to January 16, 2002, are summarized as follows:

1. Discharge: Discharge reached a maximum of approximately 30 cfs on both May 1 and May 16 at the upper and middle sites, and reached a maximum of 40 cfs on May 16 at the lower site (Figure 40b). This result indicates that a source or sources other than upstream flow contributed to the discharge, and therefore water quality, at the lower site. This conclusion is also supported by discharge measurements made in June, July, and August when discharge was at its lowest at the upper site. Sources of flow at the lower site may include subwater, but it is more likely that discharge is supplemented by discharge from irrigation canals. Discharge at the lower site dropped from 30 to 40 cfs on May 16 to 0.5 to 3 cfs on May 31, probably due to decreased runoff and diversion of water for irrigation. Flow was altered in August at the middle site by construction of a beaver dam, and samples were not collected at any of the sites in December or January because the stream was frozen.

2. Total Suspended Solids: The target concentration for TSS recommended by DEQ to protect water quality is less than 80 mg/L (Table 15). The highest concentrations of TSS in Moody Creek were measured at the upper and middles sites on May 16 and at the lower site on May 1, and generally corresponded to dates with high discharge measurements (Figure 40b). The TSS values on these dates ranged from 57 to 174 mg/L, as compared to a range of 3 to 33 mg/L on all other dates. However, it is notable that the concentration of TSS at the lower site was only 16 mg/L on the day that discharge was highest (i.e., 40 cfs). This result is consistent with the conclusion based on flow data that indicate the primary source of water at this site is not Moody Creek.

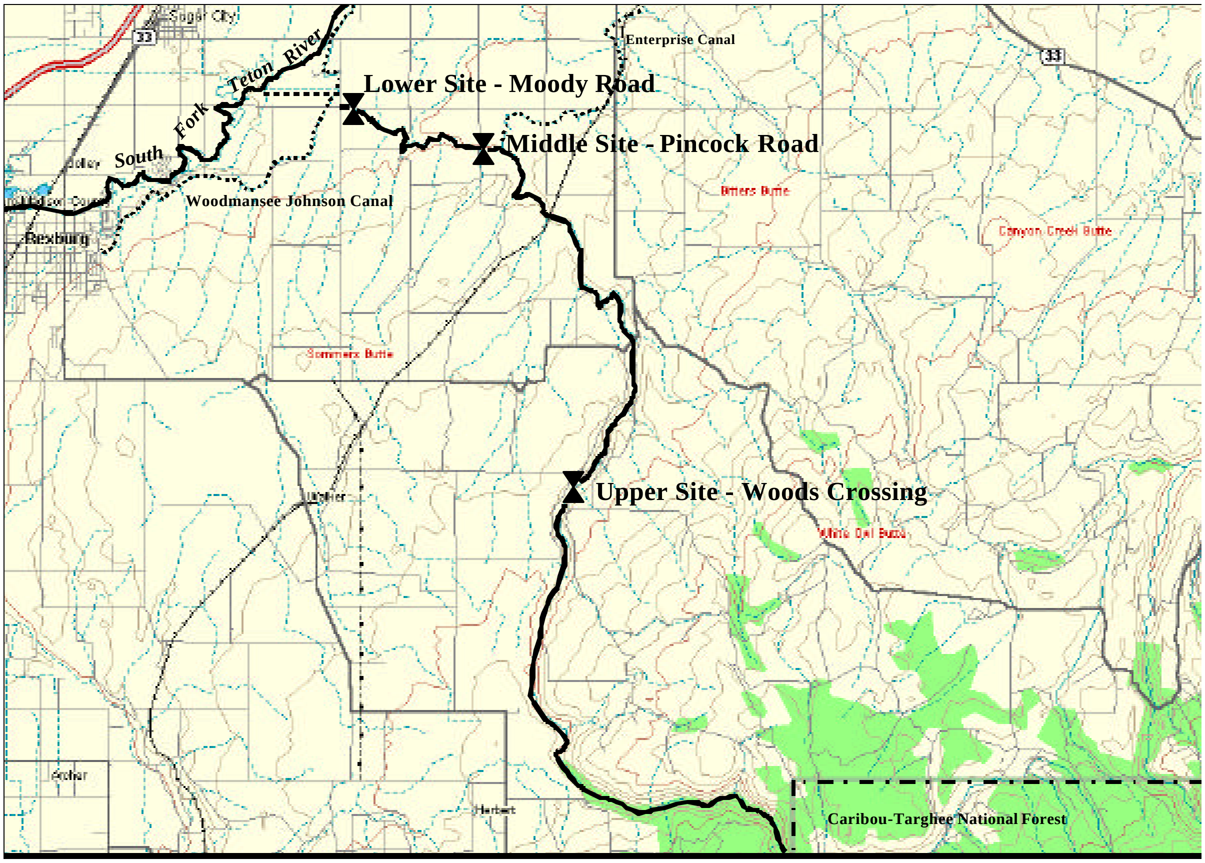

Figure 40a. Locations of Idaho Assocation of Soil Conservation Districts water quality sampling in 2001.

3. Nitrogen: The concentration of NO_2 + NO_3 in every sample analyzed was less than the detection level of 0.05 mg/L with only one exception. This exception occurred on May 16 when a concentration of 0.81 mg/L NO_2 + NO_3 was measured at the lower site. Again, this result indicates that the primary source of water at the lower site was not Moody Creek, and that nitrate is not. contributing to nutrient enrichment in Moody Creek. However, the results of analyses performed in 2000, and the results of ammonia analyses performed in 2001, cast doubt on the validity of the NO_2 + NO_3 results. Only three of 12 samples collected in 2001 did not contain detectable concentrations of NO_2 + NO_3 (Appendix I), but seven samples contained concentrations ranging from 0.11 mg/L to 0.29 mg/L. Furthermore, the concentrations of ammonia measured at the middle and lower sites in 2001 exceeded 0.1 mg/L on several dates (Figure 40b). These ammonia concentrations are more consistent with concentrations found in effluent from municipal wastewater treatment facilities than with concentrations found in natural surface waters. Ammonia is generally not detectable in natural surface waters because it rapidly dissipates to the atmosphere under ambient conditions of dissolved oxygen and pH. It appears that the 2001 results may have been transcribed (i.e., ammonia reported as NO_2 + NO_3 and NO_2 + NO_3 reported as ammonia), or that the results reported for ammonia were actually the results of an analysis of ammonia plus organic nitrogen.

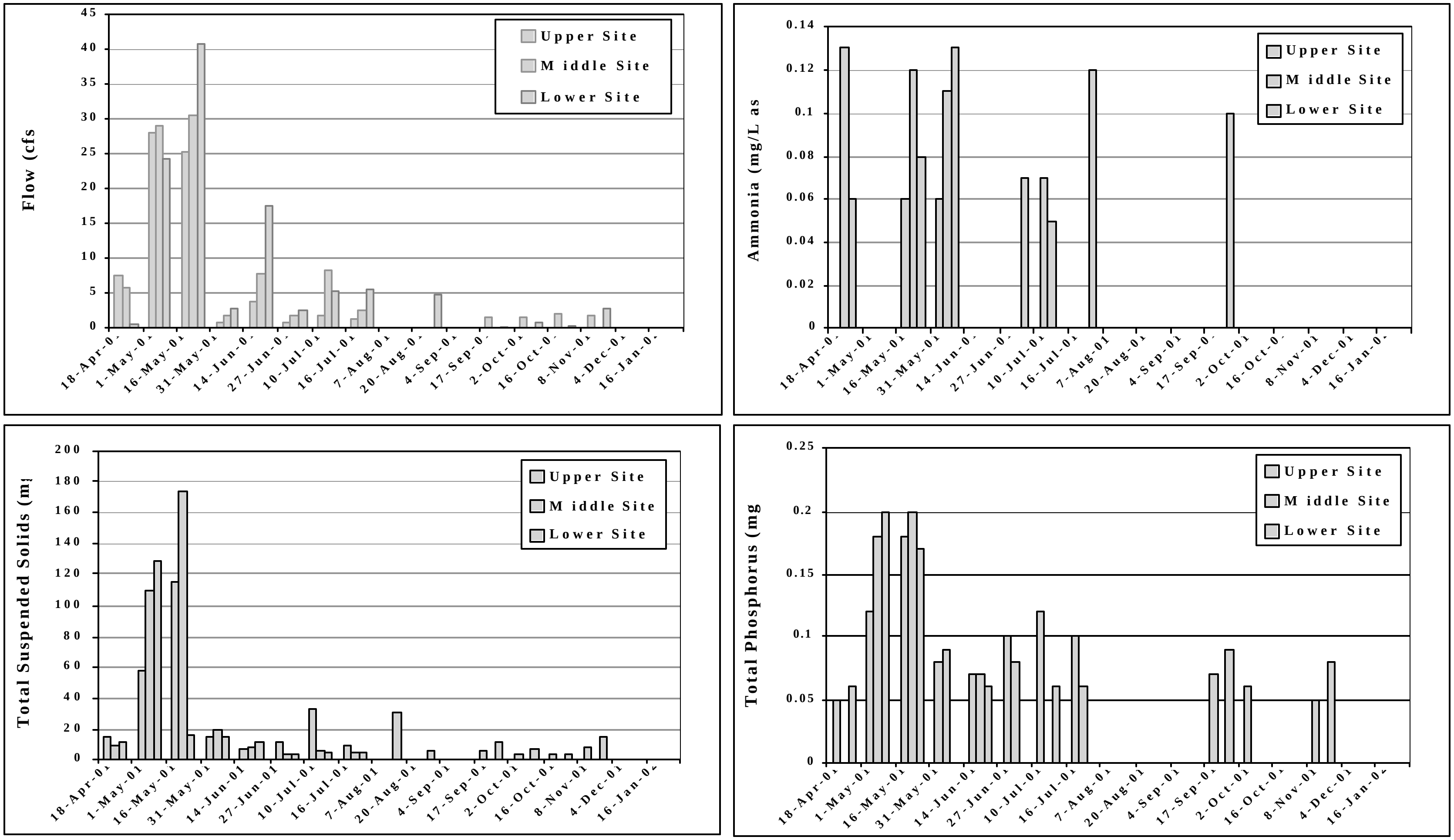

Figure 40b. Results of selected water quality analyses performed on samples collected at three locations on Moody Creek in 2001 (Fischer 2002) . Samples were not collected at the middle site from 7 August through 8 November because the stream had been dammed by beavers.

4. Total Phosphorus: As shown in Table 15, the concentration of total phosphorus in flowing streams should remain below 0.1 mg/L to prevent biological nuisance. The concentrations of total phosphorus measured at all locations in Moody Creek in 2001 were generally below this level except on May 1 and May 16, when maximum discharges and maximum TSS concentrations were also measured (Figure 40b). The concentration of total phosphorus also exceeded 0.1 mg/L at the upper site on July 10 when an abrupt increase in TSS was also recorded. These results indicate that total phosphorus in the water column is associated with sediment suspended in the water column during runoff. It is possible that elevated concentrations of total phosphorus in Moody Creek results from naturally elevated concentrations of phosphorus in soil and not from agricultural activity.

5. Temperature: The instantaneous temperature criterion of 22 ^{o}C for cold water aquatic life was exceeded by 0.1 ^{o}C on July 10 at the middle sampling site. In addition, instantaneous temperature measurements exceeded the maximum daily average criterion for cold water aquatic life (19 ^{o}C) on at least one date at each sampling site. As indicated by the sampling results obtained in 2000, these data also indicate that temperature monitoring using thermographs is warranted at several locations on Moody Creek.

Several sources of sediment in the upper Moody Creek subwatershed were identified during fish habitat surveys conducted by the Forest Service. The surveys was conducted on Moody Creek, North and South Moody Creeks, Ruby Creek, and Fish Creek (Figure 40c) using the R1/R4 fish habitat inventory described by Overton *et al.* (1997). At the request of DEQ, survey crews also performed stream erosion inventories using a worksheet developed by Terril Stevenson, geologist with the Idaho state office of the NRCS. The stream erosion inventory consists of six factors that are indicative of the susceptibility of streambanks to erosion: evidence of bank erosion, ability of banks to withstand erosion caused by flow, bank cover, channel stability, channel substrate, and deposition of sediment. Scores for each factor are summed, and a cumulative score ranging from 0 to 4 indicates slight erosion, a score ranging from 5 to 8 indicates moderate erosion, and a score ranging from 9 to 13 indicates severe erosion.

The stream erosion inventories were performed on sections of the stream considered by the field crew to be representative of the entire reach. Almost half of the narrative fish survey reports provided by the Forest Service included descriptions of sources of sediment and recommendations for reducing sediment loads (Table 27). Sources of sediment included streambank erosion due to grazing, off-road vehicle use in riparian areas, ATV use in riparian areas, proximity of roads to stream reaches, un-improved stream crossings, and insufficient vegetative cover on steep slopes. The streambanks in nine of the 16 reaches for which cumulative erosion ratings were reported were moderately eroding, five were slightly eroding, and two were severely eroding. According to the survey data sheets provided by the Forest Service, the instantaneous temperature criterion of 22 ^{o}C for cold water aquatic life was matched on reach 2 of North Moody Creek on June 27 and was exceeded by 3 ^{o}C on August 6 on reach 5 of South Moody Creek.

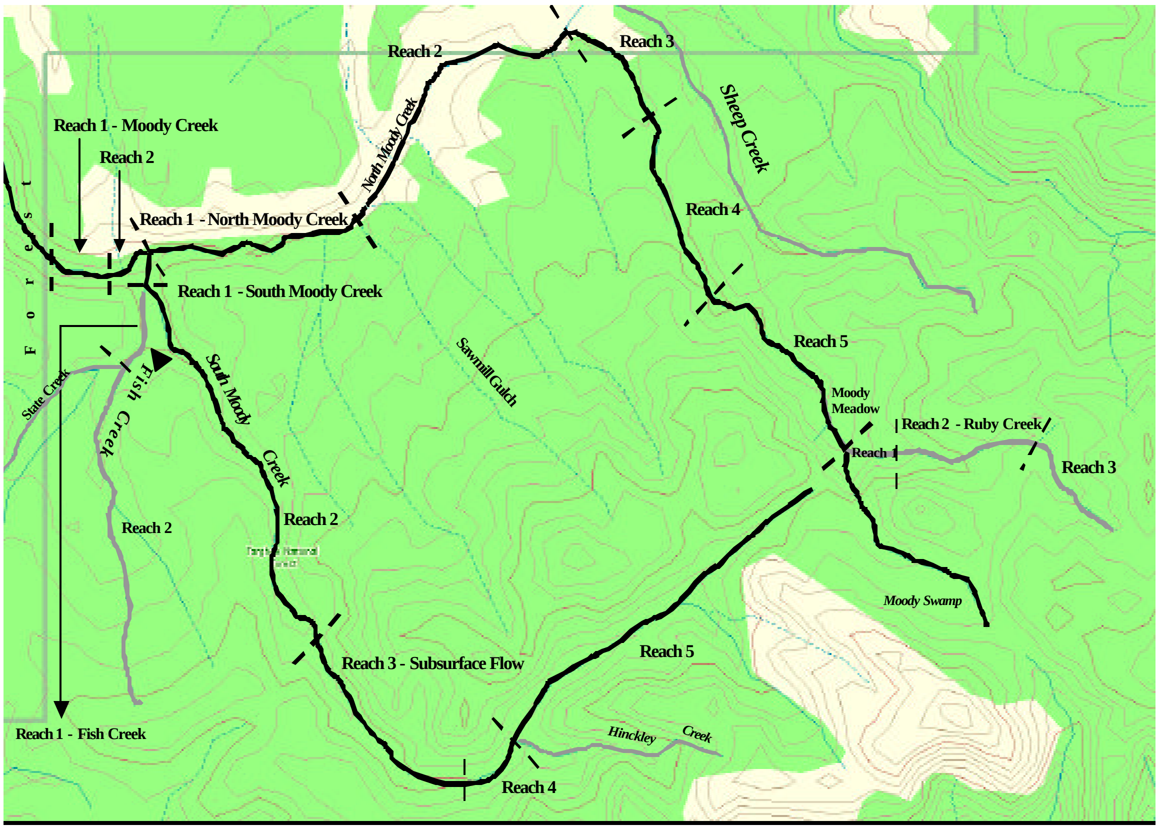

Figure 40c. Boundaries of reaches on North Moody, South Moody, Ruby, and Fish Creeks that were surveyed by the Caribou-Targhee National Forest in 2001 as part of the Forest's Yellowstone cutthroat trout management program.

Table 27. Summary results of the fish habitat inventory conducted in the Moody Creek subwatershed in 2001 by the Caribou-Targhee National Forest.

Stream	Reach Number and Boundaries	Survey Narrative Comments and Recommendations	Cumulative Erosion Rating[1]
Moody Creek	1 - Forest boundary upstream to spring	Generally in good condition due to valley confinement and healthy riparian zone. Where disturbances had occurred, streambanks were damaged and unstable. Exclude cattle and ATVs from sensitive riparian areas.	8
Moody Creek	2 – Spring to confluence of North and South Moody Creeks	High ATV activity and grazing contributing to streambank erosion. Restrict access to the riparian area by cattle and ATVs.	8
North Moody Creek	1 – Confluence of North and South Moody Creeks to Sawmill Gulch	Lack of vegetation on steep, south-facing slope is a pathway for sediment delivery to the stream. Exclude cattle and off-road vehicles from the riparian area. Address recreation impacts. Close illegal vehicle trails. Monitor upland grazing, particularly on south-facing slopes.	5
North Moody Creek	2 – Sawmill Gulch to confluence of Sheep Creek	Protect sensitive riparian areas from overuse by cattle and campers. Exclude ATVs from off-trail activities.	10
North Moody Creek	3 – Confluence of Sheep Creek to change in channel type	Much of the stream is in good condition and appears to be healing past damage.	5
North Moody Creek	4 – Change in channel type to change in channel type	Best condition observed. Riparian area healing, banks stabilizing, fine sediments decreasing. Exclude cattle from sensitive riparian areas.	5
North Moody Creek	5 – Change in channel type to confluence with Ruby Creek	Generally good condition but sediment delivery from road likely. Relocate segments of the riparian road to reduce sediment delivery.	1
Ruby Creek	1 – Confluence with North Moody Creek to tributary	Temperature 10 degrees lower in Ruby Creek than in North Moody Creek, apparently because of lush vegetation. Identify opportunities to reduce sediment delivery from FS Road 218 to the stream.	2
Ruby Creek	2 – Tributary to tributary	Habitat and temperature optimal, but no fish observed.	2
Ruby Creek	3 – Unspecified	Habitat and temperature optimal, but no fish observed.	1
South Moody Creek	1 – Confluence of North and South Moody Creeks to confluence of Fish Creek	Area heavily used by livestock and recreationists. Exclude cattle from the riparian areas, close dispersed campsites, delineate campsites to reduce impacts on riparian areas, increase enforcement of off-road vehicle use, restrict off-road vehicle access in riparian areas and stream channels.	7
South Moody Creek	2 – Confluence of Fish Creek to area of subsurface flow	Much of the riparian vegetation has been damaged by severe overuse. Livestock grazing and recreational activities within the riparian zone should be limited. Enforcement of motorized vehicle use is required. Dispersed camping areas should be relocated.	7
South Moody Creek	4 – Area of subsurface flow to confluence with Hinckley Creek	Sediment levels increased due to high recreational use and proximity to FS Road 218. Investigate opportunities to relocate FS Road 218 away from stream, exclude livestock from riparian area, restrict off-road vehicle use and enforce regulations, provide a bridge at designated road crossing.	8
South Moody Creek	5 – Confluence of Hinckley Creek to headwaters	Investigate opportunities to relocate FS Road 218 away from stream, exclude livestock from riparian area, enforce off-road vehicle regulations.	-
Fish Creek	1	Livestock and ATVs should be excluded from the riparian area to protect and restore the riparian area and aquatic habitat.	6
Fish Creek	3	Livestock and ATVs should be excluded from the riparian area to protect and restore the riparian area and aquatic habitat.	3
Fish Creek	4	Livestock and ATVs should be excluded from the riparian area to protect and restore the riparian area and aquatic habitat.	11

[1]A score of 0-4 indicates slight erosion, a score of 5-8 indicates moderate erosion, and a score of 9 or greater indicates severe erosion.

Discussion The results of data provided by the Idaho Association of Soil Conservation Districts and Forest Service indicate that TMDLs for sediment and temperature are warranted for Moody Creek from the headwaters to the point at which Moody Creek becomes indistinguishable from the Woodmansee Johnson Canal during the irrigation season. This point should be determined by DEQ in consultation with representatives of the Woodmansee Johnson Canal Company, Fremont-Madison Irrigation District, Madison Soil and Water Conservation District, and the NRCS Rexburg field office. Because sediment and temperature for Moody Creek were not specified on Idaho's 1998 §303(d) list, load allocations for these pollutants may be developed after completion of the current TMDL schedule. This will provide time to collect temperature data using in-stream thermographs, and to identify sources contributing to elevated temperature (e.g., areas of inadequate stream shading). Because of the thorough nature of the documentation collected by the Forest Service in 2001, it may be possible to develop sediment load allocations for North Moody Creek, South Moody Creek, and Fish Creek by the end of 2002 or early 2003.

To develop a load allocation for the segment of Moody Creek downstream of the confluence of North and South Moody Creeks, additional water quality data must be obtained. Ideally, turbidity and TSS should be monitored during runoff in the following reaches: Moody Creek on state endowment lands, Moody Creek upstream and downstream of Webster Dam, Moody Creek between Webster Dam and Woods Crossing, and Moody Creek between Woods Crossing and the Woodmansee Johnson Canal. In addition, sampling should be conducted at locations downstream of intermittent discharges and canals. Such sampling will require a significant investment in personnel and equipment to reach the sites.

Conclusions Conclusions regarding the water quality status of Moody Creek are listed below.

1. A load allocation for nutrients (i.e., total phosphorus) is scheduled for completion by the end of 2002. Additional sampling must be performed to determine the background concentrations of total phosphorus in the Moody Creek subwatershed in order to determine whether a load allocation is warranted. If it is warranted, the load allocation will be developed using data collected by the Idaho Association of Soil Conservation Districts in 2001, and data that will be collected by the Idaho Association of Soil Conservation Districts and DEQ in 2002. Efforts will be made to develop a coordinated sampling program with the Madison Soil and Water Conservation District, Idaho Association of Soil Conservation Districts, DEQ, and possibly the Caribou-Targhee National Forest and Idaho Department of Lands.

2. Regardless of when load allocations are developed, the following stream segments and pollutants will be added to Idaho's 2002 §303(d) list: Moody Creek from the confluence of North and South Moody Creeks to the Woodmansee Johnson Canal (sediment and temperature), North Moody Creek (sediment and temperature); South Moody Creek (sediment and temperature), and Fish Creek (sediment).

Packsaddle Creek

Packsaddle Creek originates on the Caribou-Targhee National Forest on the east slope of the Big Hole Mountains. The headwaters of North Fork Packsaddle Creek drain from an elevation of approximately 8,000 feet to Packsaddle Lake at an elevation of 7,350 feet. From the lake, North Fork Packsaddle Creek flows more than 2 miles east where it joins South Fork Packsaddle Creek. South Fork Packsaddle Creek receives flow from streams originating in several canyons at elevations as high as 8,200 feet, and flows more than 3 miles in a northeasterly direction to its confluence with North Fork Packsaddle Creek. From the confluence of the forks approximately one-quarter mile upstream of the forest boundary, the Packsaddle Creek channel continues more than 3 miles to its confluence with the Teton River.

Almost all of the 7,008 acres that comprise the Packsaddle Creek subwatershed, as delineated in the *Teton River Basin Study* (USDA 1992), are located on the Caribou-Targhee National Forest in Wyoming. Below the forest boundary, the subwatershed is limited to a small area north and south of the stream channel. Forest lands are managed for elk and deer winter range, semi-primitive motorized recreation, and timber commodity resource development (USDA 1997a). Grazing also occurs on the forest, and two abandoned coal mines are located in the South Fork Packsaddle Creek drainage. Private lands are used for irrigated and nonirrigated cropland and rangeland (USDA 1992). A 240-acre subdivision, Packsaddle Creek Estates, is located immediately north and east of the forest boundary.

On the National Forest, the Packsaddle Creek subwatershed encompasses several ecological units (Bowerman *et al.* 1999). North Fork Packsaddle Creek occurs in ecological unit 1315, which is characterized by hilly slopes and incised drainageways. Summits support forest canopies of mixed conifers and quaking aspen. Soils are very deep and well drained with a moderate-to-high soil erodibility. South Fork Packsaddle Creek occurs in ecological units 1303, 1315, and 1576. These units include unstable and stable foothills and mountains and rolling slopes. Vegetation varies from sagebrush steppe to mixed conifers. Soils are very deep, well drained, and moderately erodible, though mass movements are common in unit 1303. Lower South Fork Packsaddle Creek and the mainstem of Packsaddle Creek are in unit 2606. This is a moist floodplain characterized by a flat bottom, moderate gradient, and frequent flooding. Seasonal variation is dominated by snowmelt.

On privately owned agricultural land, three soil associations occur on between the forest boundary and the Teton River (USDA 1969). These are distinguished in part by slope and contour, ranging from sloping to gently undulating to level. All soils are well drained.

Flow Both the North and South Fork Packsaddle Creeks are shown as perennial streams on USGS 7.5-minute topographic maps. The forks join to form the mainstem of Packsaddle Creek approximately 0.25 miles above the forest boundary. From the confluence of the forks to approximately 1.5 miles downstream of the forest boundary, Packsaddle Creek is shown as perennial. The final 2 miles of Packsaddle Creek above its confluence with the Teton River are shown as intermittent.

In the late 1970s, a pipeline was installed on Packsaddle Creek 0.5 miles downstream from the forest boundary. The pipeline is oriented north to south, and distributes water to lateral channels oriented east to west. From approximately June 1 to September 15, most of the water is diverted from Packsaddle Creek to the pipeline. A small volume of water may continue downstream approximately 0.75 miles, but the channel then becomes dry approximately 10 months of the year. Continuous flow from the headwaters of Packsaddle Creek to the Teton River may occur during spring runoff before water is diverted to the pipeline.

Water District 1 measures discharge in Packsaddle Creek at the pipeline and presumably before it is diverted into the pipeline. Eighteen-year average flow data indicate that high flows of approximately 38 cfs occur in mid-May, slowly decline in June to approximately 14 cfs, then continue to decline to 2 cfs by the end of November (Figure 41).

§303(d)-Listed Segment The segment of Packsaddle Creek shown on the 1998 § 303(d) list extends from its headwaters to the Teton River (Figure 42). The pollutants of concern are sediment and flow alteration.

The results of BURP sampling conducted in 1995 and 1996 indicated that the beneficial use of cold water aquatic life was supported in South Fork Packsaddle Creek (MBI of 3.91 at site 95-B003) and North Fork Packsaddle Creek (MBI of 5.11 at site 96-Z032), but not in the mainstem of Packsaddle Creek (MBI of 2.44 at site 95-B005). The MBI score for North

Fork Packsaddle Creek was among the highest in the Teton Subbasin, and the HI scores for all three sites (111 at site 95-B003, 112 at site 96-Z032, and 106 at site 95-B003) far exceeded the score considered to support cold water aquatic life in this ecoregion (89).

Scores for substrate embeddedness and percentage of substrate fine sediment did not indicate that sediment was a greater problem downstream than upstream. Substrate embeddedness was rated optimal at the site on the north fork and sub-optimal at the site on the south fork and the mainstem. The percentage of surface fine sediment less than 1 mm in size was lowest at the site on the north fork (25%), highest at the site on the south fork (46%), and intermediate at the site on the mainstream (38%). Bank stability exceeded 99% at each site and bank cover exceeded 90%.

Resource Problems Identified by the USDA and TSCD The *Teton River Basin Study* (USDA 1992) estimated that the total sediment yield from agricultural lands in the Packsaddle Creek subwatershed was 3,589 tons/year. Of that amount, 69% originated from land use and 31% originated from streambanks. Implementing structural practices, identified as Alternative 2 in the *Teton River Basin Study* (USDA 1992), was expected to reduce total sediment yield to 1,430 tons/year by reducing land use erosion by 22% and streambank erosion by 57%. The agricultural land located in the subwatershed occurs within treatment units 4, 9, and 12. Sediment and nutrient transport during critical erosion periods was identified as the resource problem in treatment unit 4. The causes of resource problems identified for treatment unit 9 included sheet, rill, gully, wind, and irrigation-induced erosion caused by pulverized soil surface conditions following potato harvest, spring barley seedbeds that lack adequate surface residues, fall disking, over-tilled mechanical summer fallow, up and downhill potato planting, soil compaction, and

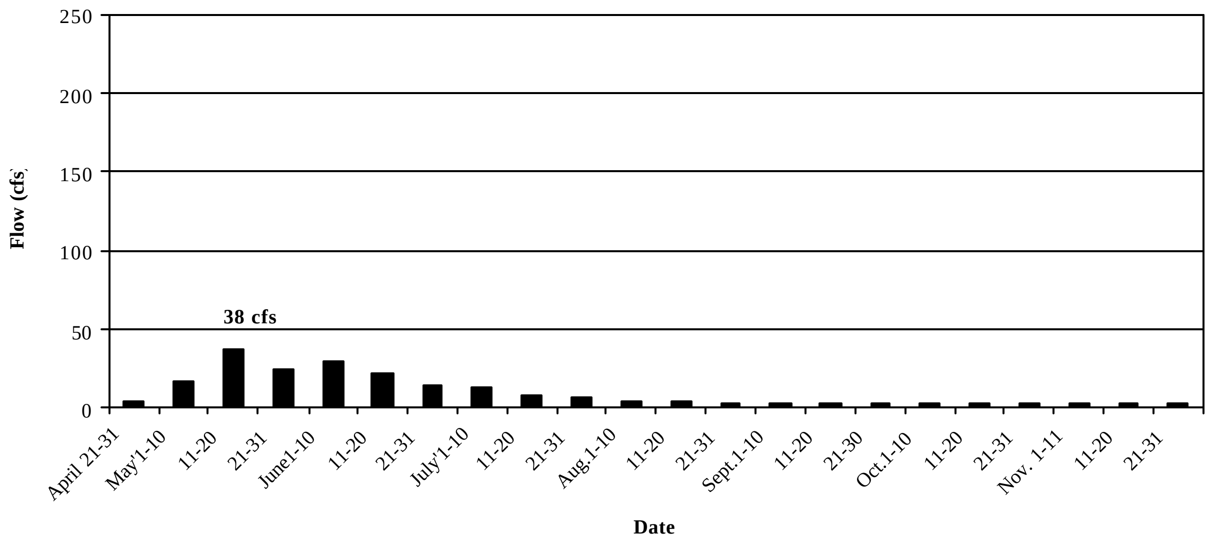

Figure 41. Eighteen-year average discharge measurements for Packsaddle Creek.

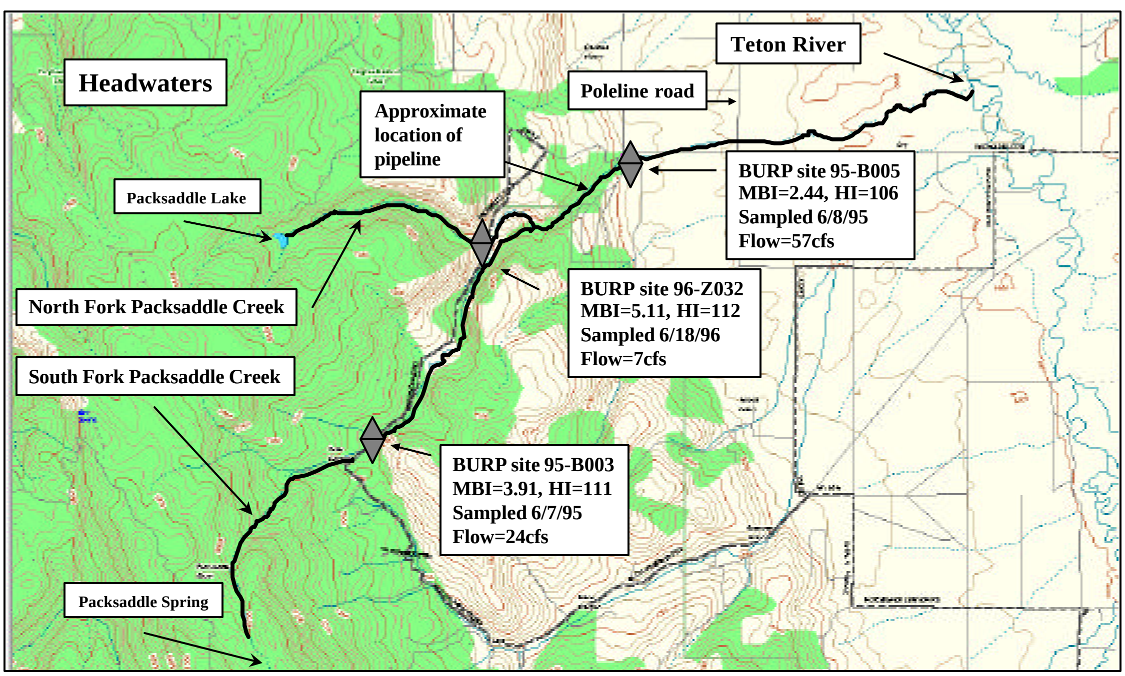

Figure 42. Data collection sites on Packsaddle Creek and boundaries identified on Idaho's 1996 section 303(d) list of water quality-impaired water bodies. Pollutants of concern included sediment and flow alteration.

over application of irrigation water. The causes of resource problems in treatment unit 12 were overgrazing of uplands, season of use by livestock, roads, overland runoff/surface and gully erosion, and urbanization/home building.

Water Quality Data The locations sampled by DEQ in 2000 did not correspond to the BURP sites sampled in 1995 or 1996. Because of the limited amount of time available to travel between sites, only two sites were sampled. The upstream site was located at a bridge downstream of the forest boundary and upstream of any cultivated land. The downstream site was located one mile downstream of the pipeline diversion on the west side of Poleline Road.

The results of water quality sampling did not indicate high concentrations of suspended sediment in Packsaddle Creek at the locations and times sampled (Appendix I). The maximum concentration of TSS measured at the upstream site on June 13, 2000, (2.9 mg/L) was far below the designated target of 80 mg/L. The maximum turbidity value (3.5 NTU), which was measured at the upstream site on June 26, was also far below the criterion specified in Idaho's water quality standards (i.e., not greater than 50 NTU above background). On June 13, the concentration of nitrate at the downstream site was 4.16 mg/L. This value is so high that it indicates the presence of a concentrated source of nitrogen, a sampling error, or an analytical error. There were no additional nitrate analyses performed for this site because the stream was dry on all subsequent visits. Nitrate concentrations at the upstream site were very low, ranging from 0.03 mg/L to 0.06 mg/L.

The downstream site was dry on three of four sampling dates, which supports observations that the channel is dry in this reach most of the year. Discharge was less than 2 cfs on June 13, 2000, and 0 cfs on June 26, July 26, and August 22. During the same period, discharge at the upstream site decreased from less than 3 cfs to 0.5 cfs.

The amounts of subsurface sediment measured in 2000 at the upstream sampling site exceeded target values. The cumulative percentage of particles smaller than 0.85 mm was 13% and the cumulative percentage of particles smaller than 6.3 mm was 34%. These values exceed the target for particles less than 0.85 mm by 3% and the target for particles less than 6.3 mm by 17%.

Samples of water from Packsaddle Creek at its confluence with the Teton River were collected by DEQ on seven dates in 1989 and 1990 (Drewes 1993). Discharge decreased from 36 cfs in May to 1 cfs in June 1989, indicating that flow was continuous from the headwaters to the river. The highest turbidity value was measured on the same date as the highest discharge, but it was only 5.5 FTU. Total suspended sediment concentrations were not measured but low turbidity values indicated that large concentrations of suspended sediment were not being transported to the river. Phosphorus, orthophosphate, and NO_2 + NO_3 concentrations were all less than 0.06 mg/L, indicating that excessive concentrations of nutrients were not being transported to the river from Packsaddle Creek.

Fisheries Packsaddle Creek was electrofished in September 1996 by DEQ at BURP site 96-Z032 on North Fork Packsaddle Creek and 100 m upstream from BURP site 95-B003 on lower Packsaddle Creek. Three age classes of brook trout, including young-of-the-year, were collected at both sites. Based on these results, Packsaddle Creek and North Fork Packsaddle Creek were assessed as supporting salmonid spawning.

The Caribou-Targhee National Forest electrofished North Fork and South Fork Packsaddle Creeks in July 1998. Brook trout and cutthroat trout were collected in both creeks, though brook trout appeared to be the dominant salmonid species.

Discussion Packsaddle Creek does not flow year-round from its headwaters to the Teton River. Discharge data collected in 1989 and 1990 at the confluence of Packsaddle Creek with the Teton River indicated that flows were sufficient to reach the Teton River in April, May, and June. Most of the flow in Packsaddle Creek is diverted from June to September to a pipeline located downstream of the forest boundary. When DEQ assessed Packsaddle Creek for the 1998 §303(d) list, the assessment of "not full support" for cold water aquatic life was based on sampling conducted at a site downstream of the pipeline. This site was sampled in early June when discharge was 56 cfs, indicating that flow had not yet been diverted to the pipeline. At a later time in the year, this site would probably have been dry.

Because of the typically dry condition of Packsaddle Creek below the pipeline, in 1999 the Henry's Fork Watershed Council Water Quality Subcommittee recommended that Packsaddle Creek be divided into two segments for the purpose of assessing beneficial uses. The upper segment extends from the headwaters of the North and South Fork Packsaddle Creeks to the pipeline; the lower segment extends from the pipeline to the Teton River. Fisheries and BURP data indicate that upper Packsaddle Creek supports the beneficial uses of cold water aquatic life and salmonid spawning. Flow data and observations by local residents indicate that lower Packsaddle Creek cannot support these beneficial uses because it is usually dry.

Conclusions Conclusions regarding the water quality status of Packsaddle Creek are listed below.

1. Discharge in the segment of Packsaddle Creek that appeared on the 1998 §303(d) list is intermittent from the pipeline diversion to the confluence of the channel with the Teton River. The biological indices used by DEQ to assess the beneficial uses of cold water aquatic life and salmonid spawning were developed using data collected for aquatic insect or fish communities sampled in perennially flowing reference streams. Similar species diversity and other community measures cannot be expected to occur in channels that periodically become dry. Therefore, it was not appropriate for DEQ to use data collected using the BURP protocol to assess beneficial use support of Packsaddle Creek below the pipeline diversion.

2. For the purpose of assessing beneficial use support using data collected according to the BURP protocol, DEQ should sample only from the headwaters of North Fork and South Fork Packsaddle Creeks to the pipeline diversion.

3. Water quality in the segment of Packsaddle Creek downstream of the pipeline diversion is protected by numeric criteria when water is in the channel, and turbidity during runoff should be monitored to determine whether this criterion, as an indicator of sediment, is exceeded.

4. To support beneficial uses, the water quality targets for sediment shown in Table 15 should not be exceeded at any location in Packsaddle Creek.

5. Development of a TMDL for sediment is appropriate based on subsurface sediment data collected in 2000 and information collected by the TSCD in the early 1990s (USDA 1992). Although Packsaddle Creek has been assessed as supporting its beneficial uses at two locations upstream of the pipeline diversion, it appears to be a source of sediment for the Teton River.

6. While Packsaddle Creek is impaired due to flow alteration, a TMDL for flow will not be developed. The EPA does not believe that flow (or lack of flow) is a pollutant as defined by section 502(6) of the CWA. DEQ is not required to establish TMDLs for waterbodies impaired by pollution but not pollutants, so it is the policy of the state of Idaho to not develop TMDLs for flow alteration.